ALFALFA

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CONTENTS

ALFALFA:

THE SUPREME HAY CROP FOR OHIO

Alfalfa is a very old forage plant, having been utilized as a feed for livestock in the Eastern Hemisphere more than 2000 years, from whence it was slowly spread to most countries of the entire world. In the United States it is comparatively new. Alfalfa was first introduced into the colonies in the eastern part of the United States, but on account of unfavorable soil conditions it largely disappeared. It first became an important crop in California about 1854, from seed of Chilean origin. Since that time it has been grown with more or less success under a wide range of climatic and soil conditions. Many partial or complete failures have occurred, due largely to lack of knowledge of proper soil and climatic requirements, the use of unadapted seed, failure to provide inoculation, or because of improper methods of seeding. In the face of all of these difficulties, the acreage in the United States increased from approximately 5,000,000 acres in 1910 to 11,000,000 in 1925.

The First Alfalfa in Ohio.—In Ohio the first successful alfalfa was grown in Ross, Hamilton, and Lake Counties. However, it is the late Joseph E. Wing of Champaign County to whom we are indebted for establishing alfalfa as one of the staple farm crops in Ohio. It was due largely to his efforts between 1890 and 1900 that alfalfa was recognized by Ohio farmers as a valuable hay crop.

Ohio's Alfalfa Acreage.—A survey of the alfalfa acreage in Ohio, conducted by the Ohio Agricultural Experiment Station and reported in 1907, shows that between 10,000 and 15,000 acres were grown in the state, distributed in every county except Monroe and Vinton. Since 1907 the increase has been gradual, reaching a total of 152,000 acres in 1924. (See Fig. 1.) This acreage, however, represents only 5 per cent of the entire area devoted to hay in Ohio.

Climatic Adaptation of Alfalfa.—Alfalfa is adapted to a wide range of climatic conditions. It is true that alfalfa is naturally adapted to growing under irrigation or in regions of somewhat less rainfall than that in Ohio, yet it does exceedingly well in more humid regions. Throughout this state injury may occur during periods of heavy rainfall on soils that are difficult to drain. On these same soils winter injury from freezing and thawing and the use of unadapted seed is a greater menace to the crop than high summer temperatures and heavy rainfall. Yet there is no part of Ohio where the climate prevents the successful culture of alfalfa.

In fact, alfalfa is a prime forage crop far north of Ohio and also grows well in more southern latitudes. It has been observed making splendid growth in sections where the rainfall is more and less than that of this state. We must conclude that where drainage is adequate climatic conditions are not a limiting factor to successful alfalfa production in Ohio.

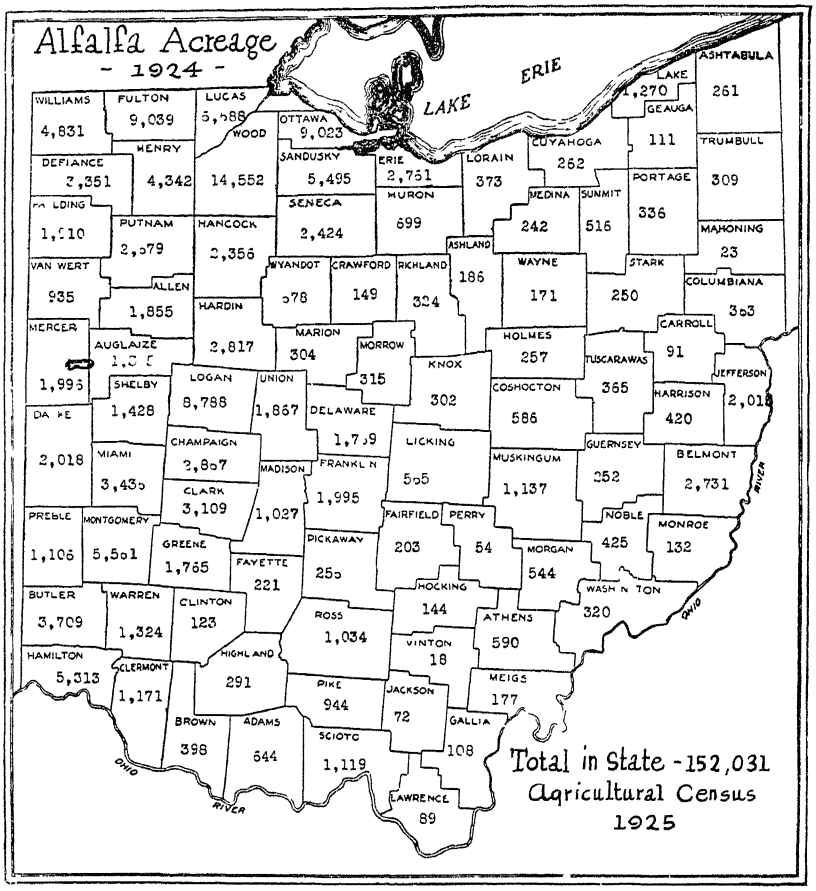


FIG 1
In Champaign County, 2867 should read 3867

Why Alfalfa Should Be Grown in Ohio.—Alfalfa is a nearly perfect forage crop. No other crop in Ohio can be as successfully utilized in so many different ways. As a hay crop its yield per acre and quality exceed that of other forage crops. It contains a high percent of protein and mineral matter, and when fed in combination with corn, which furnishes the carbohydrates, it is unsur-

passed. As a pasture it has a high carrying capacity and is especially good for hogs. It can be successfully ensiled or ground into a meal for feed. Corn, small grains, potatoes, etc., grown after alfalfa produce higher yields than following the small clovers. Contrary to general opinion alfalfa does fit into regular crop rotations. It may be left for one, two, or three years. It produces more hay per acre than red clover even in the first year of its growth. It is no more difficult to get a stand of alfalfa than of other clovers or grasses when proper soil conditions prevail.

ALFALFA AS A FEED AND SOIL IMPROVER

Alfalfa Excels as a Hay Crop

The feeding value of any crop is determined by several factors, the first of which is palatability, indicated by the amount of feed consumed. The palatability of alfalfa may be affected by the time of cutting and the curing process. Secondly, there is need of structural building material which must come largely from protein and mineral matter. Third, it must supply energy and heat. Fourth, digestibility must be considered. Hays that contain a large amount of fiber may furnish sufficient heat and energy, but lack digestibility. Alfalfa cut at the right time, and properly cured, contains a relatively high per cent of protein and mineral matter which is readily digested and assimilated by the animal.

Alfalfa May Substitute for Concentrates.—Experience and experiments have shown that alfalfa can be substituted for a part of the concentrates in the dairy cow's ration, with little or no reduction in milk flow. As a roughage for beef cattle, alfalfa is unequaled. Sheep, work horses, and brood sows do equally well when a part of their ration is alfalfa. Young stock thrive when fed alfalfa on account of the generous supply of protein and mineral so necessary in the development of bone and tissue. Alfalfa also contains vitamins necessary for the growth and development of animals. Chopped alfalfa hay or alfalfa meal is a desirable poultry feed.

Alfalfa with its protein and mineral content is especially adapted for use in a feeding ration with corn, since corn is relatively low in protein and minerals and high in carbohydrates. No other two crops will give as economical production of livestock products on the farm as alfalfa and corn. Neither crop produces as economical gains when fed alone.

Alfalfa carries nearly the same percentage of protein as wheat bran, has a better balanced mineral content, and may, therefore, be

used as a substitute for bran in the ration, thereby materially reducing the cost.

Alfalfa Compared with Other Forage Crops.—The following table* gives the average composition and digestible nutrients in 100 pounds of the dry forage:

Constituents in 100 Pounds of Dry Crop

CROP	Digestible Nutrients				Minerals
	Carb'y's lbs.	Fat lbs.	Protein lbs.	Total lbs.	Lime lbs.
Alfalfa	39.0	0.9	10.6	51.6	2.55
Red clover	39.3	1.8	7.6	50.9	2.16
Sweet clover (white)	35.9	0.5	10.0	47.0	2.56
Soybean hay	39.2	1.2	11.7	53.6	2.21
Alsike	36.9	1.1	7.9	47.3	1.40
Timothy	42.8	1.2	3.0	48.5	0.20
Corn stover (dry)	47.8	1.0	2.2	52.2	0.50

Alfalfa hay contains more crude protein than red clover hay, but is lower in fat. As the table indicates, alfalfa hay has a small margin in its favor in total digestible units compared to red clover hay. Early cut alfalfa contains more crude protein and less fiber than later cuttings. The second and third cuttings have a greater proportion of leaves than the first cutting, and these are the most valuable part of the crop.

Alfalfa Acre Yields Are High.—Alfalfa stands supremely alone in quality of hay and total yield per acre. It is recognized as being superior in palatability and feeding value when compared to other forage or hay crops. In Ohio during the past decade the average hay yield per acre has been approximately 1½ tons, while the yield of alfalfa has averaged 2½ tons. A yield of 3 or 4 tons per acre over a period of years is not uncommon on many Ohio farms; Fig. 2 shows a Clinton County field yielding 16 tons from 4 acres. On the basis of palatability and yield per acre alfalfa shows a greater superiority to other legumes than a comparison of chemical analyses and digestible units would indicate.

According to Henry and Morrison, the average returns per acre from alfalfa taken for the whole United States as compared to other feed crops, are as follows:

* Henry and Morrison—Feeds and Feeding—18th Edition.

Alfalfa Yields Compared with Other Feed Crops (U. S. Average)

CROP	Yield per acre lbs.	Digestible crude protein lbs.	Total digestible nutrients lbs.
Alfalfa hay	4,372	463	2,250
Clover hay	2,624	199	1,336
Timothy hay	2,340	70	1,134
Corn (ears and stover)	3,574	150	2,251

This table shows that alfalfa produces more per acre than any of the common forage crops, 22 per cent greater than corn which is

FIG. 2.—ALFALFA PRODUCES LARGE YIELDS
This Clinton County field made 4 tons of hay per acre.

considered one of our greatest forage plants. Also 2.3 times as much protein as clover and more than 3 times as much as corn.

Permanence of Stand.—The length of time an alfalfa plant will endure varies with soil and climatic conditions and the variety. In irrigated regions alfalfa has grown continuously over a period of 26 to 50 years, but usually these stands begin to thin out between the seventh and tenth year. In a humid climate such as that of Ohio, an alfalfa plant may live from 10 to 15 years, if soil conditions are favorable as to fertility, lime, and natural drainage. However, under the average Ohio conditions alfalfa reaches its maxi-

mum production the second and third year, and is seldom worth leaving after the fourth or fifth year.

There are several reasons why alfalfa does not successfully grow for more than 3 to 5 years, chief of which is the fact that weeds and other grasses take possession. Usually, when alfalfa has increased the nitrogen supply in a soil, it does not successfully compete with bluegrass. On soils that must be limed to grow alfalfa, there is usually a deficiency of other plant food elements, especially phosphorus, and unless phosphorus is supplied it becomes the limiting factor, causing alfalfa to be shorter lived.

Pasturing of Alfalfa

Advantages and Disadvantages as a Pasture.—The alfalfa plant is not so well adapted to pasturing as the true grasses, because it must send out new shoots every time it is nipped off, whereas the true grasses merely lengthen out at the base of the blades. Pasturing alfalfa in a moist climate is liable to injure the stand because of too close cropping and tramping. In spite of these facts it will continue to be utilized for pasture on many farms because the alfalfa plant is highly nutritious and is excelled in carrying capacity only by sweet clover.

Alfalfa may be pastured for a period of years if proper precautions are observed. That usually means very little, if any, pasturing the first year after seeding, certainly no late fall grazing, and exercising great care in keeping stock, especially horses, sheep, and cattle, off when the soil is frozen or moist. The area pastured should be sufficiently large to allow a surplus growth for one light cutting of hay during the season, and enough fall growth to hold the winter snows. It has been suggested that a good practice is to divide the pastured area into three fields by temporary fences. Pasturing could then be alternated with clipping for hay.

Alfalfa for Hogs.—Someone has said, "A field of alfalfa is a hog's idea of heaven." (See Fig. 3.) Certainly alfalfa is one of the best pastures known for hogs. Stock hogs thrive in alfalfa pasture with little additional concentrate. Alfalfa furnishes a high protein feed and, when supplemented with corn or other carbonaceous concentrates, makes a well balanced ration for growing pigs and fat hogs. Experiments conducted at Kansas Experiment Station show a pork gain of 776 pounds per acre for one season, after deducting the gain attributed to the small amount of corn fed.

Feeding tests indicate that, for best results with hogs on alfalfa pasture, a daily grain ration of from 2 to 4 pounds for each 100 pounds of live weight is necessary. According to the Maryland

Experiment Station, an acre of alfalfa pasture when supplemented in this way will produce 1 to 1¼ tons live weight and will maintain 2500 pounds live weight throughout the season. The carrying capacity of an acre of alfalfa will depend on the condition of the stand and the amount of grain fed. An acre of good alfalfa supplemented with enough grain to keep hogs gaining should carry through the season from 15 to 20 hogs weighing 100 pounds each.

Does Alfalfa Cause Bloat?—Although horses, hogs, sheep, and cattle do exceptionally well on alfalfa pasture, cattle and sheep when on such pasture are more or less subject to bloat. The bloating is caused by fermentation of the closely packed green alfalfa

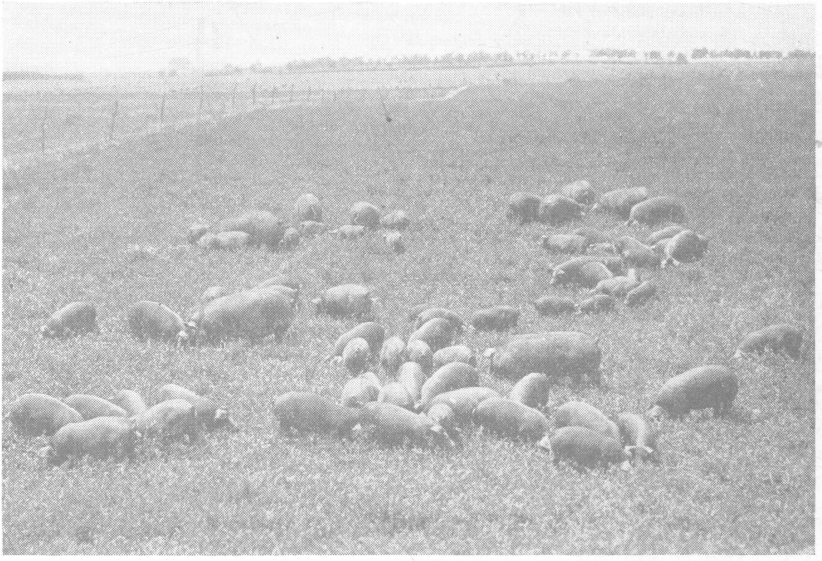


FIG. 3.—A FIELD OF ALFALFA IS A HOG'S IDEA OF HEAVEN

in the paunch of the animal. Overeating when hungry often brings on bloating and dew or rain on the plants seems to increase the danger.

Notwithstanding this tendency to bloat, cattle and sheep have been pastured on alfalfa with little or no bloating when proper precautions are observed. These are: Gradually accustoming the animal to the green plant, feeding well before turning on pasture, and having a mixture of grasses with the alfalfa. It has also been observed that turning the stock on the alfalfa after they have had a full feed, keeping them in the field continuously with plenty of water, salt, and dry roughage before them at all times, such as straw and hay, the minimum amount of bloat may be expected.

Alfalfa for Soil Improvement

Alfalfa a Prime Gatherer of Nitrogen.—Through many years of scientific investigation, no one has found a satisfactory substitute for clovers as gatherers of nitrogen and for soil improvement. In the past, Ohio farmers have relied on the old standby, red clover, for hay and soil improvement. However, during the past decade the red clover acreage has been gradually decreasing, due to the ravages of insects and diseases, to some extent the increased price of seed, and to the fact that alfalfa and sweet clover have surpassed red clover as nitrogen gatherers and soil improvers.

Enriching the Soil with Alfalfa and Manure.—One of the problems of the farmer today is how to grow crops on his soil each year and still increase the fertility of that soil. Probably the most effective way is to grow large crops and convert them into manure and return the manure to the soil supplemented with acid phosphate. From a given area more manure is available from alfalfa hay than from other hays, due to the higher acre yields of the alfalfa. The two crops, alfalfa and corn, yield the most possible feed per acre and make possible the return to the soil of the maximum amount of manure. One of the best examples of building up a run-down farm with alfalfa and manure was furnished by the late Joseph E. Wing of Champaign County. The Wing brothers fed their alfalfa to lambs, applying the manure supplemented with phosphate to other land, liming only where alfalfa was seeded. Corn yields of 100 bushels per acre were not uncommon following alfalfa.

For a comparison of the fertilizing elements contained in the top growth of the different legumes, and also in timothy and corn stover, the following table is submitted:

Fertilizing Constituents Per Ton (Dried Roughage)*

CROP	Nitrogen lbs.	Phos. Acid lbs.	Potash lbs.
Alfalfa	47.6	10.8	44.6
Alsike	41.0	14.0	34.8
Red clover	41.0	7.8	32.6
Sweet clover (white)	46.4	13.2	25.2
Soybeans (hay)	51.2	13.6	46.6
Timothy	19.8	6.2	27.2
Corn stover (dry)	18.8	9.0	25.8

* Henry and Morrison—Feeds and Feeding—18th Edition.

Effect of Alfalfa Roots in the Soil.—In addition to the greater amount of manure accumulating from livestock, alfalfa is a deep rooted plant which loosens the soil, permits of better aeration and drainage, and due to the nodule bacteria has the power of fixing atmospheric nitrogen in the soil. When the fields are plowed, the roots decay rapidly, liberating large amounts of stored nitrogen; as much as 150 to 175 pounds of nitrogen per acre is not uncommon, two-thirds of which is usually contained in the first foot of soil. Yields of corn, oats, wheat, and potatoes are usually greater after alfalfa than those secured with an application of manure.

Alfalfa in the Rotation.—The fact that alfalfa is not long lived in Ohio is no reason for not including it in a 2-, 3-, 4-, or 5-year rotation. It has already been pointed out that, the first year, alfalfa outyields red clover. In parts of western Ohio where soil conditions are especially favorable, alfalfa fits into the regular crop rotations as well as red clover. It is successfully seeded in the spring with wheat and oats without special soil preparation.

A few rotations are suggested that have been found practical on many farms.

TWO-YEAR ROTATIONS:

Corn—alfalfa.
Oats—Alfalfa.
Wheat—alfalfa.
Potatoes—alfalfa.

THREE-YEAR ROTATIONS:

Corn—oats—alfalfa.
Corn—wheat—alfalfa.
Potatoes—wheat or oats—alfalfa.
Sugar beets—wheat or oats—alfalfa.
Soybeans—wheat or oats—alfalfa.

FOUR-YEAR ROTATIONS:

Corn—oats or wheat—alfalfa—wheat (sweet clover).
Corn—oats or wheat—alfalfa—alfalfa.
Corn—soybeans—wheat—alfalfa.
Potatoes—oats or wheat—alfalfa—alfalfa.
Sugar beets—oats—alfalfa—alfalfa.
Corn—sugar beets—oats—alfalfa.

These rotations may be continued in alfalfa 1 or 2 years as desired. Red clover can also be substituted between the oats and wheat, or a mixture of alsike and timothy or timothy alone may be added to the alfalfa.

On many farms where alfalfa is grown successfully, it is not always desired to have as many acres of alfalfa as of the other

crops in the rotation. A smaller field of alfalfa that is not included in the regular rotation may be depended on for hay, and sweet clover used in the rotation for soil improvement and pasture.

On farms where special soil treatments are necessary to grow alfalfa such as in eastern and southern Ohio, it may be advisable to prepare one field for alfalfa, maintaining the stand as long as possible through the addition of lime and fertilizer. When the alfalfa thins out or weeds and bluegrass become too numerous, the field can be plowed and grain cropped 1 or 2 years and reseeded. On this type of farm it will be necessary to use alsike, red clover, and timothy or other grasses in the regular rotation. Grain crops following these grass mixtures, when supplemented with well preserved manure and fertilizer, produce excellent yields.

GETTING A STAND OF ALFALFA

Choose Varieties Adapted to Ohio

Until recently, not much attention has been paid to varieties of alfalfa. We know now that many early failures with alfalfa, which were attributed to lack of lime, poor inoculation, or dry weather, were really due to using the wrong kind of alfalfa. There are strains of alfalfa which are not hardy at even 10 degrees above zero, while other strains are hardy at 60 degrees below zero. Varieties of alfalfa also differ in yield, color of flowers, rapidity of recovery after cutting, and other characters, so there is abundant room for choice if we can know just what is best and be sure of having it.

Common or Blue Flowered Alfalfas.—One great group of alfalfas has blue flowers. Since most of the alfalfa in the United States belongs to this group they are called "common" alfalfas. The different strains or varieties of common alfalfa are usually designated by the place where the seed was produced; Kansas common, Utah common, Dakota common, Turkestan alfalfa, etc. These strains are of very different value. All alfalfas are cross-fertilized and include many types, so whenever alfalfa is grown in a particular region for a few generations the types which are not adapted to the region die out. This natural selection produces a mixture of types adapted to the region.

In much of Ohio, winter hardiness is, next to yield, the most important requirement. Seed from sections with milder winters than Ohio is, therefore, likely to be more or less of a failure, and the farther south the seed was grown the less likely it is to give satisfaction. Common alfalfa from the Dakotas and other north-

ern states is unquestionably more hardy and hence more valuable than from farther south.

Kansas and Utah are large producers of alfalfa seed and their conditions are generally sufficiently rigorous so that seed from these sections gives vigorous results. Arizona produces large amounts of good-looking seed, which is not sufficiently hardy to be safe in Ohio. Russian Turkestan at one time furnished us considerable seed, which was particularly undesirable, being short-lived and low yielding. Just now little Turkestan seed is coming in, but it may be on the market again. Italian alfalfa is only a small factor in the market, but is essentially worthless north of the Ohio River. Several million pounds of alfalfa seed have been imported during each of the past few years from the Argentine Republic. This seed is poorly adapted, yet much of it must have reached the Corn Belt, leaving a multitude of alfalfa disappointments behind.

The Variegated Alfalfas.—Another and increasingly important group of alfalfa varieties are the variegated alfalfas, so-called from the fact that some or many of the flowers are nearly white, yellow, smoky, or greenish instead of the predominant blue. This group of alfalfas had its origin in colder regions than common alfalfa, and all variegated varieties are more winter hardy than the average common alfalfa. Important commercial varieties of variegated alfalfa are Grimm, Canadian Variegated, Hardigan, Cossack, and Baltic. Grimm is the most widely known and commercially important of these. Grimm alfalfa is named for Wendelin Grimm of Carver County, Minnesota, who in 1858 sowed alfalfa seed brought from Baden, Germany. It grew well and the rigorous natural selection developed a strain of exceptional hardiness. The other variegated varieties have never been extensively tested in Ohio, but there is nothing in such tests as have been made to suggest that they are not in every way as good as Grimm. The Canadian or Ontario Variegated has been grown in Ontario for many years, and in tests there has fully equaled Grimm. There should be no doubt of its hardiness in Ohio and at present the seed is much cheaper than Grimm.

Common or Variegated?—Next to avoiding totally unadapted strains the most important question for the Ohio grower is "Shall I buy common or variegated alfalfa?" No simple answer can be given to this. When winter-killing was not a factor there has been very little difference in the yields of the two types. Some winters or conditions will kill any alfalfa, Grimm or common. Most winters Grimm and common live over equally well. But an occasional

winter, like that of 1923-1924 at Columbus, will kill common but not Grimm or other variegated types. The man who sowed Grimm in 1923 had hay in 1924, while the man who sowed common had a field to plow up. Fig. 4 shows the difference between Grimm and common on the University plots in that year. The extra price for Grimm seed amounts to an insurance premium against such a situation.

The longer one wishes his alfalfa to remain and the farther north in the state one lives, the more likely it is that Grimm or some other variegated variety will be the best to sow. The farther south one is located, and the shorter the time the field is to be in alfalfa, the more likely are adapted strains of common to be most economical.

How Can Grimm Be Identified?—Grimm seed cannot be distinguished from that of common in any way. Farmers who have

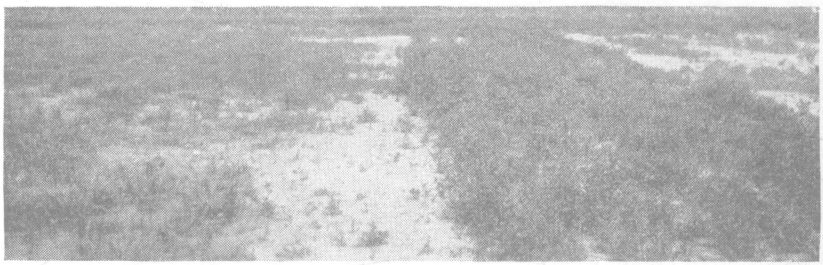


FIG. 4.—GRIMM VS. COMMON ALFALFA

The plat on the left, common alfalfa; right, Grimm; in May, 1924. Both sown August 17, 1923. Nearby stands a year older were similarly affected.

sown seed labeled Grimm, often wish to know how they can be sure that they actually have Grimm alfalfa. It is not usually possible to tell plants of Grimm from those of other varieties of variegated alfalfa, but they can usually be distinguished from common by the occasional variegated flowers and the sickle-shaped or less tightly coiled seed pods. Grimm alfalfa is slower to start in the spring than common, so that at a certain stage there is often a noticeable difference in height between them. The Grimm usually makes this up later. Grimm is also somewhat slower in recovering after cutting. This makes it less desirable in the extreme south and may be a factor in southern Ohio.

So much has been written about the "branching root system" of Grimm alfalfa that most farmers expect to be able to distinguish Grimm from common in this way. As a matter of fact, the root

systems of field stands of Grimm and common a year old or less are indistinguishable. Even with bundles of several hundred roots of each variety to compare, it has proved difficult to tell them apart. Old established plants of the two types show greater differences, but even here one cannot with certainty identify individual plants. Common alfalfa roots often branch, and Grimm alfalfa always forms a taproot first and then branches later. The roots shown in Fig. 5 are typical of field-grown Grimm alfalfa in well drained Ohio upland.

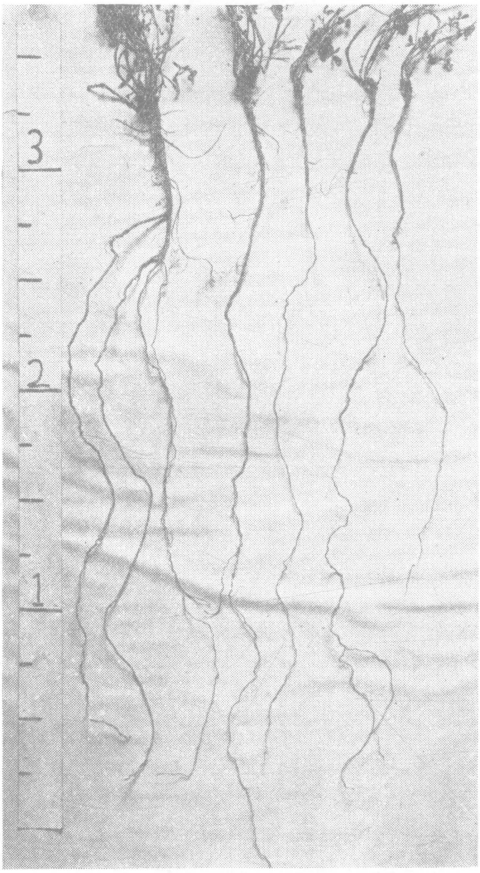


FIG. 5.—GRIMM ALFALFA ROOTS

These 2-year-old roots are from the plot shown in Fig. 4. No attempt was made to follow the roots to their full depth.

There is a great difference in the root systems of any alfalfa on different soil types — far greater than the differences between varieties of alfalfa. This is illustrated by Fig. 6, which shows at the left roots of common alfalfa on deep fertile bottom soil and at the right, roots of common alfalfa from the same field but on a different and less favorable soil type. It seems likely that the "branching root system" tradition originated in observations of Grimm alfalfa sown on unfavorable soil types, or in some instances of transplanted plants.

Grimm is reported to heave out less by freezing and thawing than common, but the difference, if it exists, is slight. The greater hardiness of Grimm is not due primarily to its heaving out less than common, but to some difference in its internal make-up, just as wheat is winter-hardy and oats are not, though both have the same habit of growth.

Can the Farmer Know What He Is Buying?—Since, with certain unimportant exceptions, the seed of these different strains of alfalfa cannot be distinguished, it becomes an important matter to know how one may secure what he asks for. Imported and southern-grown alfalfas are seldom offered for sale as such. One is largely dependent upon the integrity of the seed dealer. "Bargains" in alfalfa seed are likely to be expensive. However, many of the producers of hardy alfalfa have formed seed growers' associations, and dispose of their seed under seal. It is possible to secure known-origin adapted seed, if one sets about it.

The Federal Seed Staining Law.—As an aid to the farmer in identifying unadapted imported seed, Congress has passed a law which took effect in the summer of 1926 providing that all imported

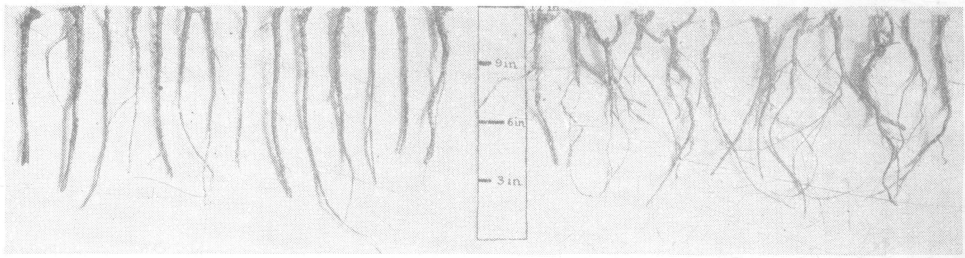


FIG. 6.—UPPER PORTION OF COMMON ALFALFA ROOTS

Left, from deep black bottom soil; right, from the same field and only a few rods away, but from hard, light colored upland

alfalfa and clover seed must be stained. Imported alfalfa seed which is formally determined by the Secretary of Agriculture to be unadapted to general use in the United States is stained approximately 10 per cent red. Canadian seed is stained approximately 1 per cent violet and other imported seed is stained approximately 1 per cent green. A little study of the seed with a hand lens will soon enable the farmer to avoid unadapted **imported** seed.

Soils Best Adapted to Alfalfa

There are several factors having to do with the soil that must be considered, if good crops of alfalfa are to be secured. It is a serious mistake to expect alfalfa to grow on soil too poor for profitable production of other crops. However, alfalfa may be successfully produced on many types of soil ranging from sands to heavy clays and on some muck soils. Deep loamy soils with porous or open subsoils are unquestionably best suited for alfalfa. It has been

demonstrated that the soils of the humid region that are naturally adapted to the growing of alfalfa are rich in lime carbonate, are fairly productive, and are naturally well drained.

Soils of Limestone Derivation.—In Ohio, the largest area possessing these qualities lies within the western half of the state, as indicated in Fig. 7. Good examples of such soils are the brown rolling uplands in the vicinity of Bellefontaine and the brown terrace soils along the Miami and Mad Rivers. In addition to these naturally drained soils, there are many large areas of darker colored glaciated and glacial lake soils in Western Ohio that are adapted to the growing of alfalfa when properly tile drained.

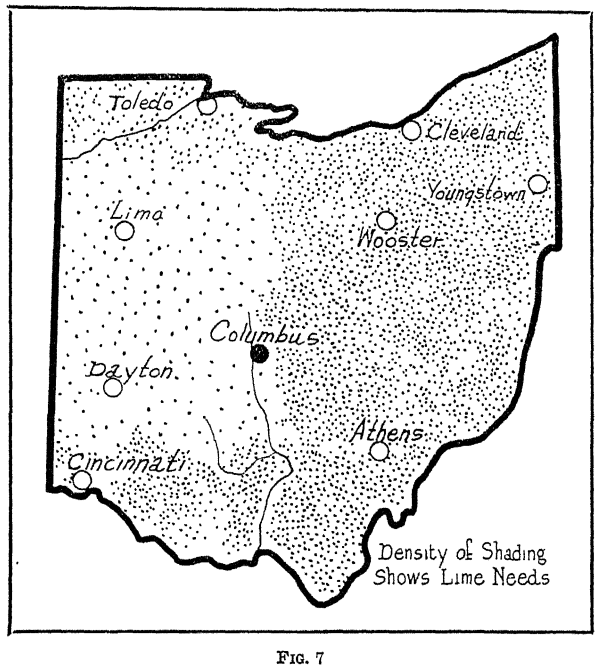


FIG. 7

Soils of Sandstone and Shale Derivation.—A large portion of eastern Ohio soils of both glacial and residual origin and also the Clermont silt loam area of southwestern Ohio must be limed, drained, and phosphated before alfalfa can be grown successfully. The majority of these soils are light colored, and with the exception of the Clermont soil were derived from sandstone and shale, which originally contained a very small percentage of lime. Most of the sandy soils found in the state have an acid reaction and must be limed. Many are low in nitrogen, phosphorus, and potash, and some need drainage before alfalfa will succeed.

Lime and Phosphate Necessary for Alfalfa

Alfalfa is one of the greatest lime-loving plants of the legume family. When compared to both legume and non-legume crops in lime consumption, we find that alfalfa heads the list as indicated in Fig. 8. All soils that show a high or moderate deficiency in lime are poorly adapted to the growing of alfalfa. Experiences in Ohio have shown that soils with an acid reaction that have received an annual application of 250 pounds of phosphate per acre, for a period of 4 or more years, will grow alfalfa with less lime than those soils receiving no phosphate. However, liming will increase the crop on these soils. It is apparent that lack of available phosphate in a soil may be a limiting factor in successful alfalfa growing.

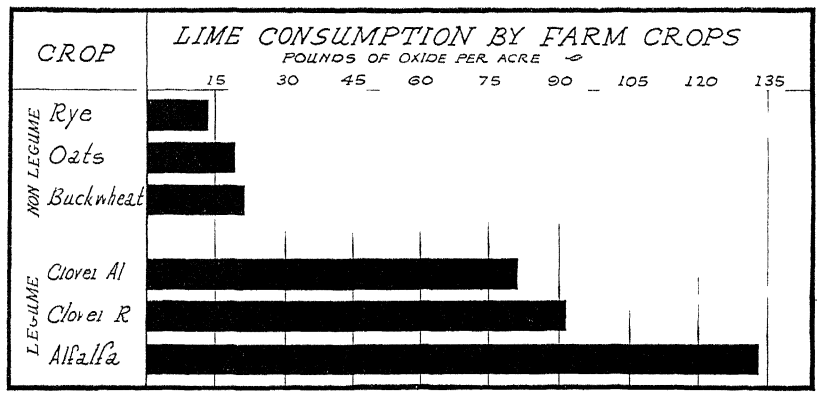


FIG 8

Scattered throughout the state are many areas that as yet have not needed an application of lime in order to grow good alfalfa. However, surveys indicate that at least 75 per cent of Ohio soils show some degree of acidity. The amount of lime required for any soil depends on the degree of acidity. Certainly those soils that did not originally contain appreciable amounts of lime carbonate will need a heavier application than those of limestone derivation. Just how frequently lime should be applied is not definitely known. On some soils that have received from 2 to 3 tons of ground limestone it is usually not necessary to lime again for a period of from 6 to 10 years. Some prefer to use smaller amounts and apply regularly each rotation. The latter method is satisfactory if the soil is not in a high state of acidity at the time of the initial application.

In liming for alfalfa, it is perhaps best to apply the lime 1 or 2 years preceding the time of seeding. This permits thorough mix-

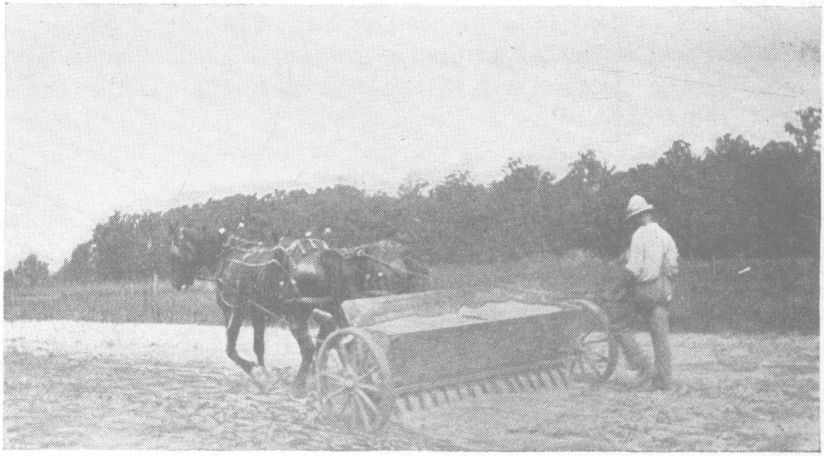


FIG. 9.—A LIME SPREADER AT WORK IN AN AUGLAIZE COUNTY FIELD

ing with the soil and neutralizing of acidity, especially if rather coarse limestone is used. There are several methods of applying lime to the soil. The regular lime spreader, shown in Fig. 9, is to be preferred as it gives a more even distribution of the liming material. The response of alfalfa to liming as an average of tests in five states is shown in Fig. 10.

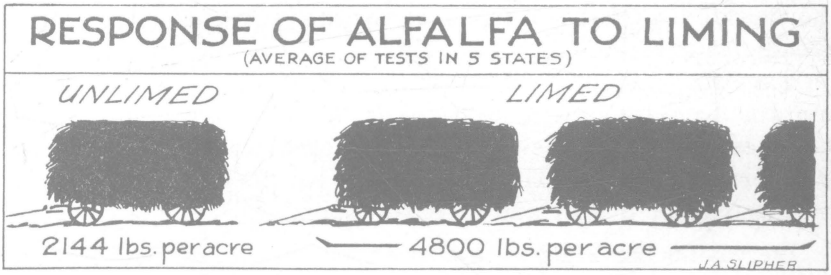


FIG. 10

Tile Drainage Essential on Some Soils

Alfalfa root development is influenced by soil moisture, texture, and height of water table. Tile drainage, to be most effective for alfalfa, should keep the water table down to a depth of 2 or 3 feet during the growing season. The depth to which tile should be placed varies with the different types of soil. In extremely heavy soils they are not effective below the hard pan layer. On soils that possess natural drainage, such as those underlaid with sand and

gravel, tile drainage is usually not necessary. On many western Ohio soils with a heavy subsurface layer, the growing of one or two crops of sweet clover will ordinarily loosen this subsurface layer, thus aiding the effectiveness of tile drains, so that alfalfa can be grown without difficulty.

On soils that contain an impervious (hardpan) layer in the subsurface, similar to that found in the Clermont silt loam area of southwestern Ohio and some of the heavier soil areas of northeastern Ohio, tile drainage is only partially effective. It is doubtful whether satisfactory results can ever be obtained with alfalfa on these types of soil.

Alfalfa roots do not stop up tile drains unless water runs in the tile throughout the growing season, as is the case when fed by springs or used as an overflow from water tanks.

Inoculation Essential for Vigorous Growth

For the proper development of alfalfa, it is just as essential to have complete inoculation of nodule forming bacteria as it is to have well drained soil containing sufficient lime carbonate and available phosphate. If the land is not well inoculated it is highly important to supply the nitrogen-fixing bacteria in some way. One need only examine the roots to determine whether there are nodules present. These are the visible evidence of inoculation. Often when alfalfa is not inoculated there is a tendency for the growth to be pale green instead of a dark green as it should be.

Experience indicates that where the fertility of the soil is maintained and the lime content not depleted, a soil once thoroughly inoculated for alfalfa or sweet clover, will maintain that inoculation for a period of years. The bacteria die out rapidly in soils of decreasing organic matter and increasing acidity.

Increasing the Yield by Inoculation.—Inoculation will not take the place of drainage, lime, or phosphate, but on soils otherwise adapted to alfalfa, inoculation may tremendously increase the yield. Two years' results at the Minnesota Experiment Station show that inoculation when compared with no inoculation increased the dry weight per acre of alfalfa hay 472 per cent, and the dry weight of roots to a depth of 10 inches, 254 per cent. Also, the amount of nitrogen contained in the dry hay was increased 760 per cent and dry weight of roots 758 per cent.

The noticeable effects of inoculation on the growing plants are usually a more uniform stand, a more vigorous growth, and a darker green color than with plants grown with no inoculation. These

effects are more marked with alfalfa growing on soils of low fertility than on those that are rich in mineral and organic material. Inoculation does not affect the germination of the seed, but it does aid in securing a more vigorous, healthy growth after it is once started.

How to Inoculate.—Inoculation may be successfully accomplished either by treating the seed with commercial preparations or by the soil-transfer method. Commercial cultures can be obtained from most seed dealers with adequate directions for applying. These cultures cost more than soil for inoculation, but they are more convenient to use and, therefore, preferred by many.

The soil transfer method can be acomplished in several different ways, all of which are satisfactory. The soil is secured from alfalfa or sweet clover fields, known to be inoculated. Prepare the field for seeding and broadcast by hand or with a manure spreader from 200 to 400 pounds inoculated soil per acre. If the fertilizer attachment of grain drill is used, less soil is needed. It is a good practice to cultivate the field after applying the inoculation. Direct sunlight probably kills some of the bacteria, but there are millions of them, and it is not possible for the sun's rays to destroy all of them.

It is much easier and just as satisfactory to dry, at room temperature, soil taken from around the roots of inoculated alfalfa or sweet clover plants, pulverize, and dust on the seed at the rate of 2 quarts or more to 1 bushel of seed.

Rate of Seeding

One pound of alfalfa seed contains approximately 220,000 seeds. If alfalfa were seeded at the rate of 5 pounds per acre there should be 25 seeds on each square foot. A seeding of 15 pounds per acre would place 75 seeds on each square foot. Ordinarily 20 to 25 plants per square foot is considered a good stand, hence, if all the seeds developed into plants, a satisfactory stand might be secured with only 5 pounds of seed per acre, but many seeds do not make plants and there is also a high mortality among the young plants. The use of 10 pounds of seed per acre is recommended (see Fig. 11).

The quantity of seed per acre necessary for a good stand varies somewhat with the viability of the seed, the condition of the seedbed, the manner of seeding, and the type of soil.

In the past the rate of seeding in Ohio has been 15 to 20 pounds per acre. Experiments indicate that more than 15 pounds per acre decreases the yield. Three years' work with high and low

rates of seeding in Canada resulted in the highest yield per acre for the 15-pound seeding. The experience of many good farmers indicates that 10 to 12 pounds of adapted seed of high germination sown broadcast gives better results than heavier rates of seeding. If soil conditions are such that 15 pounds will not give a stand, it is folly to hope to succeed by sowing 20 or 30 pounds, having twice as many plants to die.

On sandy soils with a limited supply of moisture, thinner seedings are advisable, as the plants in a thin seeding have the advantage of more moisture than in a heavy seeding, thereby giving the plants a chance for greater root development and a more rapid penetration to the retreating moisture supply.

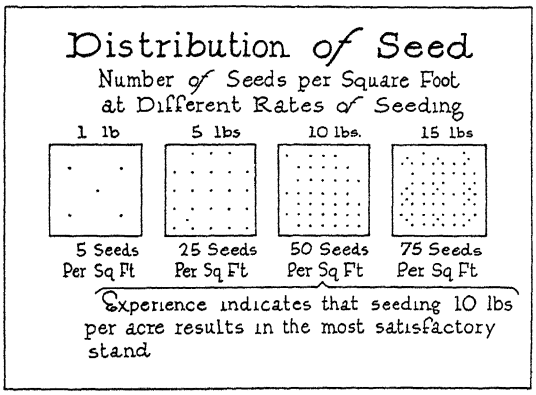


FIG. 11

Seeding Mixtures

Because alfalfa produces two or more cuttings in a season, it was formerly thought not advisable to seed with mixtures of other clovers or grasses. During recent years seeding mixtures are becoming more and more popular. The addition of some alsike, red clover, or timothy is advocated for safety purposes to insure a crop growth on the poor or acid spots in the field. This may also increase the yield and aid in curing the first cutting of alfalfa.

The first crop of alfalfa is ready to cut before the timothy is in bloom and is very palatable and high in feeding value. With this mixture the second and third cuttings are almost entirely alfalfa. Comparative tests of 16 mixtures at the Ontario Agricultural College at Guelph, Canada, for an average of 6 crops, gave yields per acre as follows: alfalfa alone 4.9 tons; tall oat grass and alfalfa 5.2 tons; orchard grass and alfalfa 4.9 tons; timothy and

alfalfa 4.6 tons; tall fescue and alfalfa 4.5 tons; common red clover 3.4 tons.

Various amounts of seed in the mixture have been tried. Apparently a full seeding of alfalfa and about one-fifth of this weight of timothy is most satisfactory. Another mixture made up of alfalfa 8 pounds and sweet clover 4 pounds is used in a 4-year rotation of corn, oats, hay, wheat (sweet clover). This alfalfa-sweet clover mixture is seeded in the oats and the following year the first cutting is largely sweet clover, but two cuttings of pure alfalfa may be secured after the sweet clover has disappeared. From the standpoint of increasing the soil fertility, and the number of crops harvested in the four years, this rotation is unexcelled. On the heavy, dark colored soil areas, a cutting of sweet clover hay can usually be secured after oats or wheat harvest.

Method of Seeding

Seeding After Summer Fallow.— Formerly the general practice was to seed alfalfa on land that had been summer fallowed. The chief advantages of this method are, (1) Plowing can be done at any time in spring or late winter and successive growth of weeds can then be killed with cultivator or harrow. (2) A firm fine seedbed can thus be assured. (3) By seeding in midsummer on fallow land the young plants need not compete with other crop plants for moisture and plant food.

Some difficulties are encountered, however, when seeding in midsummer in this manner. (1) The use of the land is lost for one whole crop season in getting alfalfa established, unless the seeding follows an early crop of potatoes or of canning peas. (2) Usually very dry hot weather is prevalent in midsummer which does not permit of prompt and even germination of the seed, or sufficient root development of the young plant to withstand cold winters. (3) Entirely too much labor is required to maintain a fallow for one whole season.

Spring Seeding with Nurse Crop.—Seeding alfalfa in the spring with a nurse crop or companion crop has many advantages over midsummer seeding on fallow land, and is now generally practiced. It is by far the most economical method since no labor is required in preparing the seedbed. At this time of the year the land is full of moisture and is quite compact. The grain crop with which alfalfa is seeded soon shades the ground and helps to keep the weeds in check. Fig 12 shows a good stand of alfalfa obtained by seeding on wheat in the spring.

While this method has many advantages there are also some difficulties to be encountered. The grain crop competes with the young alfalfa for plant food, sunlight, and moisture. If the grain crop lodges before harvest time, it is almost sure to smother the young alfalfa.

What Is the Best Companion Crop?—The success attained by seeding alfalfa with any particular grain crop depends somewhat on the location. In northern Ohio alfalfa is usually sown with wheat, oats, or barley as the grain crop. Early oats or barley gives most general satisfaction, because, on most soils, early maturing grains do not as a rule produce rank stalk growth or consume as much moisture as later maturing ones, and, on account of the early harvest, more moisture is available for the young alfalfa plants.

FIG. 12.—ALFALFA SOWN IN TRUMBULL WHEAT, OHIO STATE UNIVERSITY FARM

This alfalfa was in a four-year rotation of corn-soybeans-wheat-alfalfa. The alfalfa has proved both surer and larger yielding than red clover wherever the land is limed and drained. This wheat made 33 bushels per acre.

In southern Ohio alfalfa is usually sown with wheat. There is no doubt that the soil is in better state of cultivation to receive the seed when alfalfa is sown with a spring grain crop such as oats or barley than with winter wheat, also, the alfalfa has an even start with the grain.

Sometimes alfalfa can be seeded in corn at last cultivation (see Fig. 13).

Drilling vs. Broadcasting.—Satisfactory alfalfa stands are often secured by broadcasting the seed when the soil is "honeycombed" from frequent freezing and thawing. However, this is not a safe practice to follow year after year. An added insurance when broadcasting is practiced is to sow half of the seed at an early date in one direction and the other half at a later date in the opposite direction. Alfalfa seed will germinate more uniformly and completely if covered to a depth of ½ inch in most soils. In sandy

soils or droughty conditions, covering the seed 1 inch or more is safer.

Seeding with alfalfa drill or ordinary grain drill with grass-seed attachment instead of broadcasting, often means the difference between a good stand and a partial or complete failure. Seeding with a drill requires less seed per acre and insures a more even distribution. On wheat ground, when the soil becomes firmly settled over winter, it is often necessary to loosen the soil in order to cover the seed. The seed will be covered better if drilled across the wheat rows. On some of the lighter colored, more compact soils, it may be advisable to follow the drill with a harrow to in-

FIG. 13.—PLOT ON LEFT SHOWS ALFALFA SEEDED IN CORN AT LAST CULTIVATION
(Ohio Agricultural Experiment Station)

sure complete covering of the seed. When sowing alfalfa with spring seeded grain crops, the problem of covering the seed is quite different. In fact if the soil is loose, it is best to let the alfalfa and seed fall on the surface behind the disks to prevent covering the seed too deep. The seed dropped on the loose soil slightly ridged by the disks of the drill will be covered sufficiently by the rains that follow.

Clipping New Seedings

If possible, young alfalfa should not be clipped until it blooms. After removing the nurse crop, alfalfa on good soil may come into bloom and even make a fair cutting of hay. If this occurs before

September 1 the alfalfa may be cut without injury. More than one cutting is never secured after a nurse crop. Usually when alfalfa is sown alone any time before July 15 weeds choke the young alfalfa. If this occurs the field should be clipped. Sometimes the weeds will be injured more than the alfalfa and the stand saved, but it is better to sow early with a nurse crop and avoid the necessity. Summer sown alfalfa should never be clipped.

Fertilizing Alfalfa

Alfalfa in short rotations is usually not fertilized after seeding. Where it is left more than 3 years it will often pay to fertilize the stand. Farm manure is often recommended and will nearly always produce an increase in the yield of alfalfa. However, this is a wasteful use of manure. The most valuable constituent of farm manure is nitrogen, of which inoculated alfalfa can secure unlimited quantities from the air. It is better farm management, therefore, to use the manure on corn, wheat, timothy, or some other nonlegume.

Phosphorus in the form of acid phosphate nearly always gives an increase when applied to alfalfa as a top dressing. This would be expected, since most Ohio soils are deficient in phosphorus, and the 4 tons of alfalfa which should be produced each year on an acre of Ohio alfalfa will contain as much phosphorus as is contained in 270 pounds of 16 per cent acid phosphate. On most soils 200 to 300 pounds of acid phosphate each year will give good results as a top dressing on established alfalfa. Potash will also give good returns on many soils, but its use in Ohio is not so well worked out as is that of phosphate. Commercial nitrogenous fertilizers have never shown a profit when used on alfalfa.

Cultivation of Alfalfa

The tap roots of established alfalfa are so large and tough that it is possible to work the ground around them rather vigorously without injuring them. The best implement for this purpose is a modified spring tooth harrow, one with narrow teeth which can stir the soil and tear out grass without cutting the roots. The next best implement is an ordinary spring tooth harrow. The disk harrow was at one time recommended for this purpose, but is so far inferior that it should probably never be used. A disk will not thicken an alfalfa stand by splitting the crowns. In so far as it cuts the crowns it injures the alfalfa.

The only value in any of these treatments is to tear out and kill bluegrass, crabgrass, and other weeds, or perhaps, to mix fertilizer with the top soil. Whether the process is sufficiently beneficial to pay for the labor required or even beneficial at all, has not been definitely proved, although many experienced alfalfa growers believe that it is a valuable means of rejuvenating alfalfa fields which have been invaded by bluegrass. There is no doubt but that bluegrass can be torn out by a narrow spring tooth harrow without much injury to the alfalfa; but it is a question if it might not be better to simply plow up the field. Any cultivation which does not eliminate weeds is a waste of time.

HARVESTING

Cutting Alfalfa

Cutting at Early Bloom Seems Best.—It is impossible to state definitely just when is the best time to cut alfalfa. Experiments designed to determine this have given conflicting results and the same rules do not fit all conditions. Taking all things into account, however, it seems that for conditions in Ohio, the best time to cut alfalfa is shortly after it comes in bloom. The bloom is sometimes not very conspicuous in Ohio and it may be difficult to apply this rule. When this occurs the best guide for the experienced alfalfa grower is the color of the field. Alfalfa should be cut when it begins to take on a yellowish cast, and the general appearance indicates that vegetative growth is slowing up or stopping entirely.

This general recommendation is based on a number of considerations. In the first place, cutting at this stage will usually result in the largest yield of hay for the season. In the development of the alfalfa plant, vegetative growth is extremely rapid until the plant comes into bloom. Then vegetative growth slows up and may practically cease. At the same time many leaves are dropping from the lower parts of the stems so that when alfalfa is in full bloom it may not cut as much hay as it would have cut a week earlier, and by the time the seed stage is reached the yield has always sharply decreased. This slowing up of growth and loss of leaves is illustrated in Fig. 14, showing the development of the first cutting of Grimm alfalfa in 1926.

Since alfalfa leaves contain twice as much protein as alfalfa stems, it follows that the earlier alfalfa is cut the higher will be its feeding value, because of this lower prcentage of leaves in the latter cuttings. On the Ohio State University farm in 1925, alfalfa cut May 30 contained 17.6 per cent of protein and 46 per cent of

leaves in the hay, while that cut June 25 contained only 12.5 per cent of protein and 31 per cent of leaves in the hay. These differences are probably greater than the average, but are not unusual under humid conditions.

This steady loss of leaves from the standing alfalfa after the beginning of bloom also affects the market value of the hay. The recently established U. S. grades for alfalfa hay provide that U. S. No. 1 alfalfa must contain at least 40 per cent of leaves. In 1925 it would not have been possible to have made No. 1 alfalfa from the first cutting later than the beginning of bloom.

Another practical consideration is also against late cutting. Whenever alfalfa is an important crop on the farm the harvesting is likely to spread over a considerable period of time. If one feels that he must wait until full bloom to start cutting, much of the

FIG. 14.—GRIMM ALFALFA IN 1926, SHOWING PROGRESSIVE LOSS OF LEAVES

Note that even on June 27 there are no shoots starting at the crown. This was in part due to a dry season. The half-dead shoots at the base on May 28 and June 4 are not new shoots, but suppressed shoots which started much earlier.

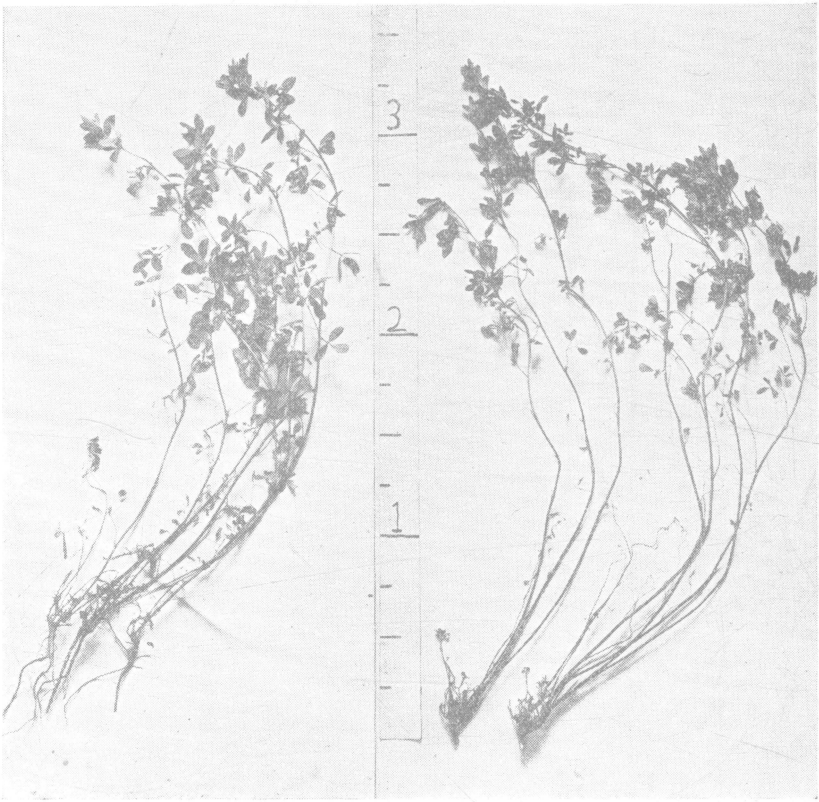
alfalfa will be in the seed stage before it is harvested, while if the harvest is started at early bloom there is some chance to get it all done by full bloom.

Because the first cutting is usually coarse it is especially desirable to cut it at an early stage if conditions will permit. This is likely to result in a larger yield for the season, because when the first cutting is taken off early the second cutting usually starts very rapidly. It is fairly certain that any possible reduction of the root reserves can be made up later.

Cutting too Early Injures the Stand.—It is dangerous to the life of the stand to cut alfalfa too early. All experiments agree on this point. Joseph E. Wing wrote many years ago, "It is better to cut it a few days late than a few days too early," and cited observations of the disastrous effect of early cutting on the stand. The earliest stage at which alfalfa can be cut without serious injury is not clear,

but the limit seems to be about as it comes into bloom. Cutting before bloom has always caused weakened stands, while cutting after bloom has commenced has only rarely caused loss.

This injury is clearly related to the reserve food stored in the alfalfa roots. The first growth in the spring or after a cutting is, of course, made from materials stored in the roots. Later, this reserve material is replaced. If the alfalfa is cut too soon there is no



June 4 June 17

FIG. 15.—LODGING CAUSES RAPID LOSS OF LEAVES.

Left, alfalfa which has just lodged, June 4; right, alfalfa from the same locality 13 days later. Note that while the plants are nearly a foot taller there are no more leaves than earlier, so that the hay is far inferior.

opportunity for the plant to build up its root reserves before they are drawn on for another crop. This process, repeated enough times, results in the weakening and death of the plants.

Late cutting has not injured the stand no matter how long the alfalfa has been left. It seems fairly clear that alfalfa should never be cut before it starts to bloom. While there is a possibility that cutting regularly in the early bloom stage may slightly weaken the

stand, the weakening is not likely to be serious within two or four years. These suggestions will ordinarily result in making the first cutting of alfalfa during the first week in June.

Late Cutting Undesirable.—Recent articles in the farm press and elsewhere have recommended late cutting of alfalfa, usually suggesting the full bloom stage. These suggestions do not apply to average conditions in Ohio. The fact that alfalfa cut as it is coming into bloom will contain from 1 to 3 per cent more protein than that cut at full bloom far overbalances a possible slight weakening of the stand.

Alfalfa should be cut promptly if it lodges. Lodged alfalfa loses leaves so rapidly that if left very long after lodging it is little but a mass of stems when harvested. Fig. 15 illustrates this.

July 19 | Sept. 10 Cut July 19 | Sept. 10 Not cut July 19

FIG. 16.—EFFECT OF CUTTING ON DEVELOPMENT OF ALFALFA, 1926.

When the short stunted growth at the left was cut July 19 the growth shown in the center was produced by September 10. When the stunted growth was not removed, little additional growth resulted, as shown at the right.

Repeated observations have shown that when alfalfa is cut too late in the fall it does not start well the next spring and is much more likely to winterkill than that which is not cut late. We need more information about this effect, but a safe practical rule is to make the last cutting early enough so that a growth of 8 inches is made before freezing weather. This will be about September 15 in northern Ohio and September 30 in southern Ohio.

Effect of Cutting on Yield.—The number of cuttings secured may be either three or four, depending on the weather conditions throughout the growing season. Three cuttings should be obtained anywhere in Ohio. In the southern part of the state four can usually be made.

It is important that whenever alfalfa leaves turn yellow and the plants stop growing and "stand still" the alfalfa should be cut, even if the growth is hardly worth removing. The stunted growth will not recover; new shoots may. Fig. 16 illustrates this. The second crop in 1926 was badly stunted on account of drouth and leaf spot, and when it was cut on July 19, the hay made less than a ton to the acre. Good rains followed and on September 10 these plots produced over 1½ tons of hay per acre. Where the stunted alfalfa was not cut, however, little growth followed when the rains came and on September 16 the plants were no larger than 5 weeks before, nor was the hay yield greater. In this instance proper cutting made a difference of over 1½ tons in the year's crop.

Alfalfa killed back by an untimely frost in the spring should be cut, even if it is so small that it cannot be raked.

What About the Shoots at the Crown?—There has been a popular rule to cut afalfa when the shoots of the next crop appear at the crown. While there are frequently young shoots at the crown when alfalfa is ready to cut neither the shoots nor the lack of them are any necessary indication that the alfalfa is ready to cut. Note in Fig. 14 that no shoots had appeared on June 28 even though this alfalfa should have been cut at least three weeks earlier. On the other hand, shoots have appeared in other years by May 15, much too early to cut for hay. Usually, also, there is no regularity about their appearance, but they keep coming over a considerable period of time.

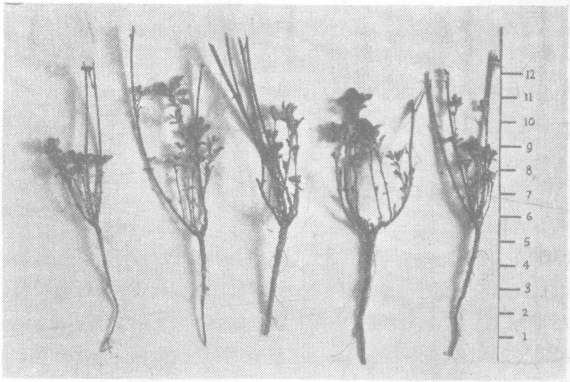


FIG. 17.—EFFECT OF HIGH STUBBLE ON ALFALFA.

Note that only very weak shoots appear near the tips of the high stubble, and that where more than one shoot starts on the same branch, the most vigorous is the one nearest the crown.

No carefully conducted experiments have shown any injury to alfalfa from cutting these shoots if they start before the alfalfa is ready to cut, despite frequent claims that great injury results if these shoots are clipped off in mowing. There are always many buds on an alfalfa crown, and no injury should or does come from cutting the young shoots. The presence of shoots should be ig-

nored or at least given very minor consideration in deciding when to cut alfalfa.

Should Alfalfa Be Cut with a High Stubble?—Sweet clover must be cut with a high stubble whenever a second crop is to follow, and because that fact has been widely advertised in recent years, some have the idea that alfalfa should also be cut with a high stubble. No mowing machine is made which will cut alfalfa low enough to injure it, since the new shoots usually come from the crown at or below the surface of the ground. Where a high stubble is left weak branches sometimes start along this stubble, but the strongest shoot is invariably the one which is lowest on the stem. Strong shoots never start from high stubble. These points are illustrated in Fig.17, showing the new growth on several alfalfa plants which had been cut with some long stubbles. Some have assumed that it is desirable to leave some leaves on the plants but there is no necessity for this. In properly treated alfalfa there is an abundance of reserve material in the roots to produce fresh healthy leaves to start off the new growth.

Curing Alfalfa

Alfalfa, especially the first cutting, has the reputation in Ohio of being somewhat hard to cure. There is no evidence that alfalfa cures more slowly than red or alsike clover cut at the same stage of maturity and the same time of year. But alfalfa is usually cut earlier in the season and at an earlier stage than red clover, and so, does cure more slowly.

No method of curing which does not involve artificial drying will make good hay when the weather is absolutely unfavorable, but it is possible to make better or worse use of the weather available.

Since alfalfa leaves are worth twice as much as alfalfa stems, every precaution should be taken to prevent loss of leaves in curing. Much of the feed constituents in alfalfa hay are water soluble and so are easily lost by rain. Losses of as much as 60 per cent of the protein and 40 per cent of the nitrogen-free extract have been reported from hay exposed to several rains in the field. Speed and economy, then, are the watchwords in the alfalfa hay field.

So much has been written about the "leaves pumping water from the stems" in alfalfa curing, that it may be worth while to mention that experiments here and elsewhere show that the leaves do not remove any water from alfalfa stems after it is cut. However, this has little bearing on practical alfalfa curing. The stems

are much slower to dry than the leaves and anything which will expose the stems to the sun and air will aid in curing the hay.

There is no perfectly satisfactory rule to determine when alfalfa is cured sufficiently to put in the barn. When hay is brittle dry so that it "rattles" it will, of course, keep without heating, but it will lose large amounts of leaves in handling and make a lower grade hay than if it had been put in earlier.

A rule frequently given is that alfalfa will do to put in the barn when no moisture can be wrung from a wisp of hay twisted in the hand, and the stems break readily. This rule, however, can only be interpreted by some actual experience, which is the only satisfactory guide to putting in hay.

Curing in Windrows.—Alfalfa may be cured in the swath, in the windrow, or in cocks. Of these curing in the windrow is by far the most practical for Ohio. Curing entirely in the swath is undesirable because the hay is bleached, a large percent of the leaves are lost in handling, and if rains come, the maximum possible damage is done. Partly cured hay should never be left in the swath overnight, as the dew will bleach it.

Alfalfa may be cut either in the afternoon or in the morning, preferably after the dew is off, but where a large acreage is to be handled even that point is not of serious importance. The alfalfa may be left in the swath until well wilted, which may be an hour, or a day, or more, depending on the weather. It may be then raked with the side delivery rake, preferably a left hand rake. If the hay is very heavy it will pay to use a tedder to stir up the hay in the swath and hasten the initial curing, but usually a tedder is not necessary. A tedder should never be used after any leaves are brittle.

Excellent results have also been secured by raking directly behind the mower with a left hand rake.

After the hay in the windrows is cured, it should be picked up by a drum or web hay loader. The rake or "kicker" type threshes the leaves badly, but a web loader (Fig. 18) will not waste as many leaves as pitching the hay on by hand.

Curing in Cocks.—For very small areas hay may be placed in small well built cocks to cure. Under careful management this will perhaps make the best grade of hay obtainable. However, curing in the cock is so much slower than in the windrow that it may happen in unfavorable weather that hay in windrows can be turned often and gotten in while that in cocks is necessarily left out to spoil. In any event the amount of labor required makes cock curing unprofitable for any but the smallest alfalfa fields.

Making Brown Hay.—It is possible to put hay in considerably greener than many people realize. When hay is put in "tough" it will heat in the mow enough to drive off the surplus water. At the same time the hay will become more or less discolored, so that the product is called "brown hay." During the process of fermentation the moisture driven off will condense on the top layer of the hay and spoil it much as the top layer of silage in the silo spoils. The top of such a mow may "steam" for three weeks or more after the hay goes in. Below this top layer in properly mowed hay, there will be no mold. This brown hay is very palatable to stock, and while there is a certain amount of loss from the fermentation, it is not serious if the hay has not been badly discolored.

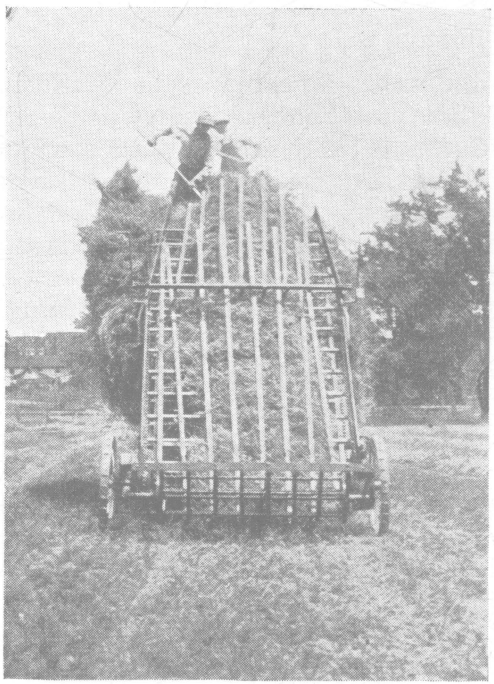


FIG. 18.—LOADING ALFALFA WITH DRUM HAY-LOADER.
Such loaders save leaves, leaves make best hay.

Someone has truthfully said that more brown hay is made by accident than by intention, and certainly we do not know a great deal about making it successfully. However, when first cutting alfalfa is nearly cured, but "tough," and the weather is such that it will be rained on if it is not taken in, it is far better to take it in and make brown hay of it, than to leave it in the field to damage by rain. If put in this way the hay should be exceptionally well mowed back, to break up green branches sometimes found. It should be packed and not left loose, unless there is space enough to spread a thin layer of the tough hay all over the mow. After fermentation starts, do not put other hay on top of it, or disturb it in any way. The use of salt on tough hay is often recommended and should be of value in reducing fermentation and mold. Rather, of the Michigan State College, recommends using a 12-quart pail of salt to a load of hay.

Spontaneous Combustion.—Spontaneous combustion is a real danger. The danger is far greater when wet hay, rather than merely undercured hay, is stored, but it seems that hay put in too green may get hot enough to burn. If spontaneous combustion is feared, the hay should not be moved. Many a farmer has found charred hay in the center of his clover mow or stack, which would have burned if air had reached it. By leaving it alone no fire resulted, while if it had been disturbed the hay and barn would have burned. The temperature of the mow can be taken by forcing a small gaspipe with the end welded to a point into the hay and lowering a thermometer in this. If the temperature goes above 212°F., flood the hay with water where it is, but otherwise it may be safely left alone. It may ignite at about 300°F.

Alfalfa Seed Production

At the present time, almost no alfalfa seed is produced in Ohio. In general, the seed crop has been uncertain and unsatisfactory, and it seems wise to let better adapted sections grow the alfalfa seed. However, the fact that there is a thriving seed industry in Ontario and considerable seed produced in Michigan, suggests that it is not impossible that Ohio alfalfa seed production may develop, although it cannot be recommended at this time. A seed crop takes as much time as two hay crops and the two hay crops will usually be more profitable.

The second or third crop is usually left for seed, though sometimes the first crop is successfully left. In general, the conditions which are favorable for a seed crop are rather thin stands and moderately dry weather, especially during the blossoming period. However, the exact conditions which lead to large seed production are not yet known. If a stand left for seed does not set a profitable seed crop it can and should be cut for hay without delay.

The seed crop is cut when three-fourths to four-fifths of the pods are black or brown. It should be handled and tramped as little as possible to avoid shattering. If the crop is short the buncher attachment to the mowing machine can be used. With a vigorous growth it is sometimes possible to use a binder or self-rake reaper.

The seed is usually threshed from the field. A grain separator is more successful in threshing alfalfa than red clover, but the clover huller is preferable if obtainable. The straw has some feeding value, comparable to corn stover, but should not be counted as more than a very coarse maintenance roughage.

SUMMARY

1. Alfalfa grows under many climatic and soil conditions.
2. That alfalfa is adapted to Ohio conditions is evidenced by an increase of 140,000 acres during the past 20 years.
3. It has a high feeding value in that it is palatable and nutritious.
4. Its yield per acre exceeds that of other common forage crops.
5. It is drought resistant, growing successfully in dry seasons when all other forage crops except sweet clover fail.
6. One seeding serves for years if soil conditions are favorable.
7. It is an excellent hog pasture.
8. Alfalfa develops healthy growth in young stock.
9. The addition of small amounts of concentrates to alfalfa pasture makes a balanced ration for fattening livestock.
10. Alfalfa pasture furnishes succulent feed throughout the growing season.
11. It enriches the soil for other crops through the addition of large amounts of nitrogen.
12. It fits into the regular crop rotation as well as red clover.
13. All imported alfalfa seed, except Canadian, should be avoided.
14. Avoid all seed produced south of Kansas.
15. Variegated alfalfas (Grimm, etc.) are good insurance against winter killing and thinning out of stands.
16. Insist on having known-origin alfalfa seed.
17. The Federal Seed Staining Law is an aid in avoiding unadapted imported seed.
18. A good alfalfa soil is well drained, contains plenty of lime and available phosphate.
19. Complete inoculation is essential for maximum growth.
20. Sow 10 to 12 pounds of viable, adapted seed per acre.
21. Adding a mixture of alsike and timothy insures a crop growth on poor or acid spots in the field.
22. Seeding alfalfa in spring with a nurse crop has many advantages over midsummer seed on fallow land.
23. Seeding with an alfalfa or grain drill often means the difference between a good and poor stand.
24. Cut alfalfa in the early bloom stage or when it is turning yellow or has stopped growth from any cause.
25. Ignore the shoots at the crown as a sign of when to cut.
26. Cut lodged alfalfa promptly.
27. Make the last cutting early enough to permit a growth of at least 8 inches before freezing weather.
28. Alfalfa contains a large amount of phosphorus and shows a quick response to applications of phosphate fertilizers.